REMARKS

Claims 12-20 are pending in this application.

Claims 12-20 are rejected.

'103 rejection of claims 12-16

The office action indicates that claim 12 is rejected under 35 USC §103(a) as being unpatentable over Gallagher et al. U.S. Patent No. 5,640,333 in view of Daughton et al. U.S. Patent No. 6,072,382. This rejection is respectfully traversed.

Claim 12 recites an SDT junction of a memory cell for an MRAM device. The junction comprises a bottom ferromagnetic layer; an insulating tunnel barrier atop the bottom ferromagnetic layer; and a top ferromagnetic layer atop the insulating tunnel barrier. The bottom ferromagnetic layer having flattened peaks.

Merriam-Websters Collegiate Dictionary, 10ed., defines flatten as "to make flat." Flattened peaks are peaks that have been made flat. Figure 5 of the application illustrates peaks that have been made flat: the peaks of the bottom ferromagnetic layer have been physically altered.

Gallagher et al. also disclose a magnetic tunnel junction 8. The structure of Gallagher et al.'s magnetic tunnel junction 8 is described on col. 4, lines 16-25, and fabrication is described in col. 5, lines 49+. However, Gallagher et al. do not teach or suggest that the peaks of a bottom ferromagnetic layer are flattened or otherwise physically altered.

Daughton et al. do not teach or suggest that the p aks of a bottom

ferromagnetic layer are flattened or otherwise physically altered. Fig. 1B of Daughton et al. illustrates a magnetic field sensor including a stack of materials. From top-to-bottom, the stack includes

Pinning layer 18
CoFe layer 17
Nonmagnetic layer 16
CoFe layer 15

Barrier layer 14 (alumina)
Second FM layer 13 (CoFe)
First FM layer 12 (NiFeCo)
Conductivity enhancement layer 11'
Insulating layer 11 (SiN)

Col. 9, lines 55-65 of Daughton et al. state that roughness of the surface supporting the barrier layer 14 should be avoided to avoid unwanted interlayer magnetic coupling between the ferromagnetic layers on either side of the barrier 14. The upper surface of the second FM layer 13 and upper surface of the barrier 14 should have a "surface roughness on the order of 2A or less on a root-means-square basis." Daughton et al. propose reducing the roughness by forming a magnetic tunnel junction (layers 12-18) on a smooth surface (the SiN insulating layer 11).

Daughton et al. describe the process for depositing the layers 11-18 at col. 11, lines 12-29. They indicate that surface cleanliness of a layer can reduce roughness in the overlying layer. Surface cleanliness is maintained by performing sputter deposition in a vacuum chamber without an intervening exposure to the atmosphere (which could allow surface contamination or oxidation to occur).

Daughton et al. do not teach or suggest that peaks at the surface of the second FM layer 13 are flattened or otherwise physically altered. Because Daughton et al. does not teach or suggest flattening peaks of a ferromagnetic layer of a magnetic tunnel junction, the '103 rejection of claim 12 should be withdrawn. Accordingly, claim 12 and its dependent claims 13-16 should be allowed over the combined teachings of Gallagher et al. and Daughton et al.

Moreover, Daughton et al. offer no teaching or suggestion whatsoever for reducing surface roughness of Gallagher et al.'s bottom-pinned magnetic tunnel junction (that is a magnetic tunnel junction in which the AF pinning layer is formed before the ferromagnetic layers). Using the insulator as an underlying SiN layer would not solve the problem of unwanted ferromagnetic coupling in a bottom-pinned magnetic tunnel junction since there would still be a lattice mismatch between the AF pinning and FM pinned layers (the lattice mismatch causes surface roughness). In Daughton et al.'s sensor, the lattice mismatch is not an issue because the magnetic tunnel junctions are top-pinned (the AF pinning layer 18 is formed on top of the second FM layer 13).

For these reasons, the '103 rejection of claims 12-16 should be withdrawn. Accordingly, claims 12-16 shoould be allowed over the combination of Gallagher et al. and Daughton et al.

'103 rejection of claims 17-20

The office action indicates that claim 17 is rejected under 35 USC §103(a) as being unpatentable over Gallagher U.S. Patent No. 5,640,333 in view of Anthony EP0929110A1. This rejection is respectfully traversed.

Claim 17 recites an array of memory cells, each memory cell including an

SDT junction, each SDT junction including a bottom ferromagnetic layer, each bottom ferromagnetic layer having an upper surface. Each upper surface has a valley-to-peak height variation of no more than about one nanometer.

The office action acknowledges that Gallagher et al. do not teach or suggest a bottom FM layer having a valley-to-peak height variation of no more than about one nanometer.

Anthony does not teach or suggest such a bottom FM layer either. Paragraph 39 of Anthony recites various thicknesses for interface layers of 1 nm or less. The office action appears to assume that an interface layer having a 1 nm thickness would inherently have a valley-to-peak height variation of no more than about one nanometer.

However, this assumption is not correct. The interface layer is deposited on a pinned FM layer having a surface roughness. The topography of the interface layer matches the topography of the underlying pinned FM layer. Therefore, it is incorrect to assume that a layer having a 1nm thickness will have a peak-to-valley height variation of 1 nm or less.

Anthony et al. do not teach or suggest a pinned FM layer having a valley-to-peak height variation of no more than about one nanometer. Therefore, the '103 rejection of claim 17 and its dependent claims 18-20 should be withdrawn.

The office action states that the applicant has not established the criticality of a height difference of no more than 1 nm. It is respectfully noted that the applicant does not have to establish the criticality of the height. However, the applicant can use criticality to rebut prima facie obviousness. See MPEP 2144.05.

The office action has not established prima facie obviousness of claim 17. Still, the application does establish the criticality of this 1 nm height difference: it has been found to significantly reduce FM coupling (see p.8, lines 20-24 of the application).

New claims 21-22

Claims 21-22 have been added to the application. These claims recite a SDT junction including a bottom ferromagnetic layer having physically altered peaks. As discussed above, none of the cited documents teach or suggest such a bottom ferromagnetic layer.

'112 rejections of claims 17-20

The office action also indicates that claims 17-20 are rejected under 35 USC §112, second paragraph, as being indefinite. This rejection has been overcome by the amendment above to claim 17.

Objections to claims 13 and 19

Claims 13 and 19 are objected to for not further limiting the claims from which they depend. This rejection is respectfully traversed. These claims recite a range of the grain angles. The criticality of grains within this angle range is, as pointed out in the application, that it is believed to produce fewer magnetic poles at the edges.

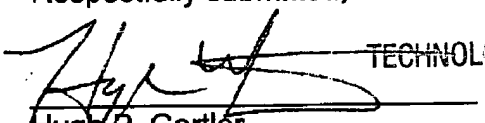
Objections to drawings

An objection to the drawings has been noticed with respect to numerals 42 and 44 of Figure 2. This objection is respectfully traversed. All three reference numerals (40-44) correspond to the black bar, which represents an insulating tunnel barrier and interfacial layers. This much should be clear from the specification.

Conclusion

The examiner is respectfully requested to withdraw the rejections of claims 12-20. If any issues remain, the examiner is invited to contact the undersigned to discuss those remaining issues.

Respectfully submitted,



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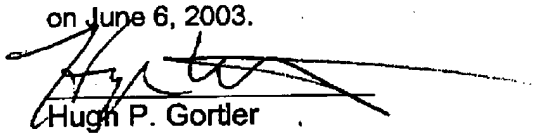

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